Naval Education and Training Command

NAVEDTRA 72540
January 1994
0503-LP-477-8900

Nonresident Training Course (NRTC)

Engineering Aid 2

Only one answer sheet is included in the NRTC. Reproduce the required number of sheets you need or get answer sheets from your ESO or designated officer.

0503LP4778900

Although the words “he,” “him,” and “his” are used sparingly in this manual to enhance communicantion, they are not intended to be gender driven nor to affront or discriminate against anyone reading this material.

NAVAL EDUCATION AND TRAINING PROFESSIONAL
DEVELOPMENT AND TECHNOLOGY CENTER (NETPDTC)
PENSACOLA, FLORIDA 32509-5000

Errata #1 5 May 1997
Stock Ordering No.
0503-LP-477-8901

Specific Instruction and Errata for
Nonresident Training Course

ENGINEERING AID 2, NAVEDTRA 72540

1. TO OBTAIN CREDIT FOR DELETED QUESTIONS, SHOW THIS ERRATA TO YOUR LOCAL COURSE ADMINISTRATOR (ESO/SCORER). THE LOCAL COURSE ADMINISTRATOR (ESO/SCORER) IS DIRECTED TO CORRECT THE ANSWER KEY FOR THIS COURSE BY INDICATING THE QUESTIONS DELETED.

2. This errata supersedes all previous errata. No attempt has been made to issue corrections for errors in typing, punctuation, etc., which are obvious to the enrollee and do not affect the student's ability to answer the questions.

3. Assignment Booklet, NAVEDTRA 82543

Delete the following questions and write "Deleted" across all four of the boxes for that question.

Question

5-12
6-58
8-9
8-27
8-30

ENGINEERING AID 2

NAVEDTRA 72540

Prepared by the Naval Education and Training Program Management
Support Activity, Pensacola, Florida

Congratulations! By enrolling in this course, you have demonstrated a desire to improve yourself and the Navy. Remember, however, this self-study course is only one part of the total Navy training program. Practical experience, schools, selected reading, and your desire to succeed are also necessary to successfully round out a fully meaningful training program. You have taken an important step in self-improvement. Keep up the good work.

HOW TO COMPLETE THIS COURSE SUCCESSFULLY

ERRATA: If an errata comes with this course, make all indicated changes or corrections before you start any assignment. Do not change or correct the Training Manual (TRAMAN) or assignments in any other way.

TEXTBOOK ASSIGNMENTS: The TRAMAN for this course is *Engineering Aid Intermediate /Advanced,* NAVEDTRA 12540. The TRAMAN pages that you are to study are listed at the beginning of each assignment. Study these pages carefully before attempting to answer the questions in the course. Pay close attention to tables and illustrations because they contain information that will help you understand the text. Read the learning objectives provided at the beginning of each chapter or topic in the text and/or preceding each set of questions in the course. Learning objectives state what you should be able to do after studying the material. Answering the questions correctly helps you accomplish the objectives.

BLACK DOT INFORMATION: Black dots (●) may be used in the text and correspondence course to emphasize important or supplemental information and to highlight Instructions for answering certain questions. Read these black dot entries carefully; they will help you answer the questions and understand the material.

SELECTING YOUR ANSWERS: After studying the TRAMAN, you should be ready to answer the questions in the assignment. Read each question carefully, then select the BEST answer. Be sure to select your answer from the subject matter in the TRAMAN. You may refer freely to the TRAMAN and seek advice and information from others on problems that may arise in the course. However, the answers must be the result of your own work and decisions. You are prohibited from referring to or copying the answers of others and from giving answers to anyone else taking the same course. Failure to follow these rules can result in suspension from the course and disciplinary action.

SUBMITTING COMPLETED ANSWER SHEETS: Complete all assignments as quickly as possible to derive maxium benefit from the course. As a minimum, you must submit at least one assignment per month. This is a requirement established by the Chief of Naval Education and Training. Failure to meet this requirement could result In disenrollment from the course.

TYPES OF ANSWER SHEETS: If you are a U.S. Navy enlisted member on active duty or a drilling U.S. Naval Reserve enlisted member, you should use the answer sheet attached at the end of this course and follow the instructions in section A below. If you are an enlisted U.S. Naval Reserve member who is not attached to a drilling unit or if you are an officer, a civilian, or a member of the U.S. Amy, Air Force, Marine Corps, or Coast Guard. you should use the Automatic Data Processing (ADP) answer sheets included in the course package and follow the instructions in section B.

A. **Manually Scored Answer Sheets**

If you are a U.S. Navy enlisted member on active duty or attached to a U.S. Naval Reserve drilling unit, your course will be administered by your local command. You must use the answer sheet designed for

manual scoring. NETPMSA form 1430/5, Stock Ordering Number 0502-LP-216-0100. You may get a supply of the forms from your Educational Services Officer (ESO), or you may reproduce the one in the back of this course booklet. DO NOT USE THIS FORM FOR COURSES ADMINISTERED BY NETPMSA.

Recording Information on the Manually Scored Answer Sheets: As you complete each assignment, submit the completed answer sheet to your ESO for grading. You may submit more than one answer sheet at a time. Remember, you must submit at least one assignment each month.

Grading: Your ESO will grade each answer sheet and notify you of any incorrect answers. The passing score for each assignment is 3.2. If you receive less than 3.2 on any assignment, the ESO will list the questions you answered incorrectly and give you an answer sheet marked "RESUBMIT." You must redo the assignment and complete the RESUBMIT answer sheet. The maximum score you can receive for a resubmitted assignment is 3.2.

Course Completion: After you have submitted all the answer sheets and have earned at least 3.2 on each assignment, your command should give you credit for this course by making the appropriate entry in your service record.

Student Questions: If you have questions concerning the administration of this course, consult your ESO.

B. ADP Answer Sheets

If you are an enlisted U.S. Naval Reserve member who is not attached to a drilling reserve unit or if you are an officer, a civilian, or a member of the U.S. Army, Air Force, Marine Corps, or Coast Guard, use the ADP answer sheets provided In your course package. You should use one blank original ADP answer sheet for each assignment. Use only the original ADP answer sheet provided in your course package; NETPMSA will not accept reproductions.

Recording Information on the ADP Answer Sheets: Follow the "MARKING INSTRUCTIONS" on each answer sheet. Be sure that blocks 1, 2, and 3 are filled in correctly. This information is necessary for your course to be properly processed and for you to receive credit for your work.

As you work the course, be sure to mark your answers in the course booklet because your answer sheets will not be returned to you. When you have completed an assignment, transfer your answer from the course booklet to the answer sheet.

Mailing the Completed ADP Answer Sheets: Upon completing an assignment, mail the completed answer sheet to:

COMMANDING OFFICER
NETPMSA CODE 074
6490 SAUFLEY FIELD RD
PENSACOLA FL 32559-5000

Use envelopes to mail your answer sheets. You must provide your own envelopes or request them from your ESO. You may enclose more than one answer sheet in a single envelope. Remember, regardless of how many answer sheets you submit at a time, NETPMSA should receive at least one assignment a month.

NOTE: DO NOT USE THE COURSE COMMENTS PAGE AS AN ENVELOPE FOR RETURNING ANSWER SHEETS OR OTHER COURSE MATERIALS.

Grading: NETPMSA will grade the answer sheets and notify you by letter concerning your grade for each assignment, your incorrect answers, and your final grade. The passing score for each assignment is 3.2. If you receive less than 3.2 on any assignment, you must rework the assignment. NETPMSA will enclose a new ADP answer sheet in the letter notifying you of the questions you answered incorrectly. You will be required to redo the assignment and resubmit the new answer sheet. The maxium score you can receive for a resubmitted assignment is 3.2.

Course Completion: When you complete the last assignment, fill out the "Course Completion" form in the back of the course and enclose it with your last answer sheet. NETPMSA will issue you a letter certifying that you satisfactorily completed the course. You should make sure that credit for the course is recorded in your service record. YOU MAY RETAIN THE TEXT.

NOTE: YOUR OFFICIAL COURSE COMPLETION DATE WILL BE THE DATE YOUR LAST ASSIGNMENT IS PROCESSED THROUGH THE NETPMSA ADP SYSTEM--NOT THE DATE YOU DEPOSIT THE LAST ASSIGNMENT IN NOT MAIL. This is especially important if you are taking the course for Naval Reserve retirement credit. You must mail your answer sheets at least 60 days before your anniversary date. This will provide you with enough time for delays in the mail or reworking failed assignments. DO NOT MAIL YOUR ASSIGNMENTS TO THE NAVAL RESERVE PERSONNEL COMMAND (NRPC).

Student Questions: Refer questions concerning this course to NETPMSA by mail (use the address on page ii) or by telephone: DSN 922-1366 or commercial (904) 452-1366.

NAVAL RESERVE RETIREMENT CREDIT

If you are a member of the Naval Reserve, you till receive retirement points if you are authorized to receive them under current directives governing retirement of Naval Reserve personnel. For the purpose of Naval Reserve retirement, this edition of the course is evaluated at 18 points. Those points will be credited as follows:

12 points for the satisfactory completion of assignments 1 through 8 and

6 points for the satisfactory completion of assignments 9 through 12.

NOTE: YOUR OFFICIAL COURSE COMPLETION DATE WILL BE THE DATE YOUR LAST ASSIGNMENT IS PROCESSED THROUGH THE NETPMSA ADP SYSTEM--NOT THE DATE YOU DEPOSIT THE LAST ASSIGNMENT IN THE MAIL. Refer to the Course Completion paragraph under section B. ADP Answer Sheets.

COURSE OBJECTIVES

In completing this Nonresident Training Course (NRTC), you will demonstrate a knowledge of the subject matter by correctly answering questions on the following: Construction Methods and Materials: Heavy Construction; Construction Methods and Materials: Electrical and Mechanical Systems; Horizontal Construction; Project Drawings; Specifications/Material Estimating/Advanced Base Planning; Care and Adjustment of Surveying Equipment; Indirect Level/Level and Traverse Computations; Topographic Surveying and Mapping; Plane-Table Topography and Map Projection; Engineering and Land Surveys; Horizontal and Vertical Curves; Electronic Surveying Equipment, and Material Testing.

Naval courses may include several types of questions—multiple-choice, true-false, matching, etc. The questions are not grouped by type but by subject matter. They are presented in the same general sequence as the textbook material upon which they are based. This presentation is designed to preserve continuity of thought, permitting step-by-step development of ideas. Not all courses use all of the types of questions available. The student can readily identify the type of each question, and the action required, by inspection of the samples given below.

MULTIPLE-CHOICE QUESTIONS

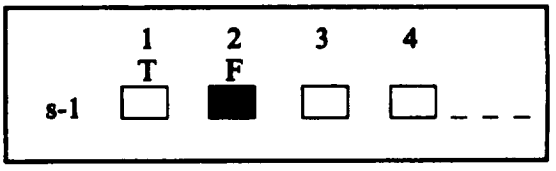
Each question contains several alternatives, one of which provides the best answer to the question. Select the best alternative, and blacken the appropriate box on the answer sheet.

SAMPLE

s-1. Who was the first person appointed Secretary of Defense under the National security Act of 1947?

1. George Marshall
2. James Forrestal
3. Chester Nimitz
4. William Halsey

Indicate in this way on the answer sheet:



TRUE-FALSE QUESTIONS

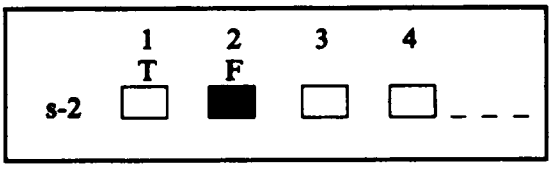
Mark each statement true or false as indicated below. If any part of the statement is false the statement is to be considered false. Make the decision, and blacken the appropriate box on the aswer sheet.

SAMPLE

s-2. All naval officers arc authorized to correspond officially with any systems command of the Department of the Navy without their respective commanding officer's endorsement.

1. True
2. False

Indicate in this way on the answer sheet:



MATCHING QUESTIONS

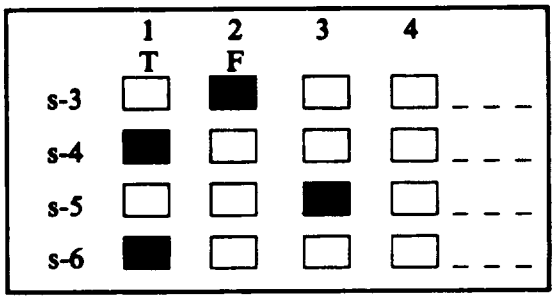
Each set of questions consists of two columns, each listing words, phrases or sentences. The task is to select the item in column B which is the best match for the item in column A that is being considered. Items in column B maybe used once, more than once, or not at all. Specific instructions are given with each set of questions. Select the numbers identifying the answers and blacken the appropriate boxes on the answer sheet.

SAMPLE

In questions s-3 through s-6, match the name of the shipboard officer in column A by selecting from column B the name of the department in which the officer functions. Some responses maybe used once, more than once, or not at all.

A. OFFICER	B. DEPARTMENT
s-3. Damage Control Assistant	1. Operations Department
s-4. CIC Officer	2. Engineering Department
s-5. Disbursing Officer	3. Supply Department
s-6. Communications Officer	

Indicate in this way on the answer sheet:



ASSIGNMENT 1

Textbook Assignment: "Construction Methods and Materials: Heavy Construction," chapter 1, pages 1-1 through 1-28.

Learning Objective: Identify the different components of a bridge and describe how those components are used.

1-1. In the Naval Construction Force (NCF), to what does the term "heavy construction" refer?

1. A project in which extra-heavy structural members are used
2. A project in which large bulks of materials are used
3. Bridge or waterfront construction
4. Each of the above

1-2. A bridge having only one intermediate support is referred to as a/an

1. single span
2. intermediate span
3. multispan
4. double span

A. Substructure

B. Abutment

C. Sill

D. Footing

E. Corbel

F. Pier

Figure 1A

IN ANSWERING QUESTIONS 1-3 THROUGH 1-7, SELECT FROM FIGURE 1A THE TERM THAT IS BEST DEFINED BY THE QUESTION.

1-3. That part of an overall bridge structure that transmits the combined live and dead loads directly to the earth foundation.

1. A
2. B
3. C
4. D

1-4. The aggregate total of all bridge components located below the stringers.

1. A
2. B
3. E
4. F

1-5. A type of structural framework that includes two or more rows of posts or piles.

1. B
2. C
3. E
4. F

1-6. One of two supports located at the ends of a bridge superstructure.

1. B
2. C
3. D
4. E

1-7. The part of a timber-sill abutment that carries the loads imposed by the stringers.

1. A
2. C
3. D
4. E

1-8. Which of the following components is NOT a part of the flooring system of a bridge?

1. Curb
2. Deck
3. Stringers
4. Handrails

1-9. What structural member(s) of a bridge carry(ies) only the live load of the traffic plus the dead load of the flooring?

1. Abutment sill
2. Pile or post caps
3. Stringers
4. Corbels

Learning Objective: Describe the terminology, methods, and materials used in foundation and pile construction.

1-10. Which, if any, of the following characteristics is common to both foundations and piles?

1. Both are always constructed of reinforced concrete
2. Both distribute the total weight of a building or structure to the natural earth
3. Both are used to resist only a vertically applied load
4. None of the above

1-11. What element of a foundation ultimately carries the total dead and live loads imposed by a building or structure?

1. Foundation bed
2. Foundation wall
3. Footing

1-12. A structural engineer is preparing to design the foundation for a large building that is to be built on a site known to have uneven subsoil conditions. What type of foundation can the engineer design that will minimize the possible effects of this condition?

1. Continuous
2. Spread
3. Grade beam
4. Mat

1-13. The larger end of a tapered precast concrete pile is its

1. butt
2. tip
3. shank
4. closed end

1-14. What type of piles should you specify for use in preventing the walls of a trench from caving in?

1. Bearing
2. Sheet
3. Batter
4. H

1-15. To join the edges of concrete sheet piles, in what form or shape are the edges cast?

1. Deep
2. Arch
3. Interlock
4. Tongue and groove

Learning Objective: Identify types of waterfront structures and their uses.

1-16. In which of the following ways are a breakwater and a jetty both (a) similar and (b) different?

1. (a) Both are used to direct the current flow in a channel (b) a breakwater is an alongshore structure
2. (a) Both are alongshore structures used to break the action of waves (b) a jetty has a paved top for vehicular traffic
3. (a) Both are offshore structures used to break the action of waves (b) a jetty directs the current flow along the line of a channel
4. (a) Both are harbor-shelter structures (b) a breakwater extends out from the shoreline

1-17. To establish a definite shoreline and maintain it against wave erosion, what type of structure should the engineer design?

1. Seawall
2. Breakwater
3. Jetty
4. Groin

1-18. To allow ships to lie alongside for loading and unloading, what type of structure should be used?

1. Wharfage
2. Offshore
3. Stable shoreline
4. Mole

1-19. In which of the following conditions can a concrete cap structure be used on a breakwater or jetty?

1. Deep-water site only
2. Extra-high tide range only
3. Deep-water site or extra-high tide range
4. Shallow-water site

1-20. How are the individual units of a precast cap structure for a breakwater (a) taken to and (b) placed in their proper location?

1. (a) Floated (b) sunk
2. (a) Carried (b) driven
3. (a) Craned (b) dropped
4. (a) Barged (b) unloaded

1-21. In which of the following uays are a seawall and a bulkhead both (a) similar and (b) different?

1. (a) Both protect a shoreline against erosion (b) a bulkhead is supported by its own weight
2. (a) Both protect a shoreline against erosion (b) a bulkhead is relatively thin and usually consists of steel sheet piles
3. (a) Both are relatively thin and self-contained (b) bulkheads are normally cast-in-place concrete structures
4. (a) Both are relatively thick and self-contained (b) a bulkhead can be constructed using wooden sheet piles

1-22. To allow ships to come alongside, bulkheads are fitted with

1. wales and anchors
2. piles and quays
3. timber caps and batter fenders
4. mooring cleats and dolphins

1-23. In what way, if any, does the purpose of a dolphin differ from that of a pile cluster?

1. Dolphins are used to protect a pier, while pile clusters protect offshore structures
2. Dolphins are used to protect moles, while pile clusters protect groins
3. Dolphins are used to protect ships only, while pile clusters protect piers only
4. None. They are both used as protection for both piers and ships

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Learnning Objective: Describe the types of fasteners and connectors used in heavy-timber construction.

1-24. What type of heavy-timber fastener has square heads and nuts?

1. Pin
2. Bolt
3. Spike
4. Rail

1-25. In timber construction, what is the minimum spacing, in inches, between bolts?

1. 9
2. 7
3. 3 1/2
4. 1 1/2

1-26. A timber fastener that is used primarily to prevent one member from moving laterally in relation-ship to another is called a

1. lag bolt
2. driftbolt
3. cleat
4. dowel

1-27. A short length of timber that is spiked or bolted to the adjoining members of a joint is a

1. connector
2. scab
3. cleat
4. block

1-28. What is the general term applied to the variety of devices used in bolted-lap joints between heavy timbers?

1. Driftpins
2. Spike grids
3. Expansion bolts
4. Timber connectors

1-29. What type of connector is embedded in circular grooves in the faces of the timbers being jointed?

1. Spike grid
2. Toothed ring
3. Split ring
4. Shear plate

1-30. Which, if any, of the following rings is/are are embedded by pressure?

1. Toothed ring only
2. Spike grid only
3. Toothed ring and spike grid
4. None of the above

Learning Objective: Identify different structural steel shapes and their uses.

1-31. What standard structural shape is most commonly used for columns?

1. C
2. HP
3. S
4. W

1-32. For what reason does the W-shape provide greater strength than the S-shape?

1. Its flanges have a greater cross-sectional area
2. Its web has a greater cross-sectional area
3. The inner faces of its flanges are tapered towards the web
4. The width of the flanges is always much greater than those of the S-shape

1-33. What does the structural-steel designation “W14 x 74” signify?

1. A W-shape member that is 74 inches long with 14-inch-wide flanges
2. A W-shape member that is 74 feet long with a 14-inch-deep web
3. A W-shape member with a 14-inch-deep web and a weight of 74 pounds per linear foot
4. A W-shape member that weighs 14 pounds per linear foot and is 74 feet long

1-34. In what way does an HP-shape member differ from a correspondingly sized M-shape structural steel member?

1. The width of its flanges are slightly larger
2. It has a greater cross-sectional area overall
3. Its flanges have a greater cross-sectional area only
4. Its web has a greater cross-sectional area only

1-35. The S-shape structural steels have a cross section shaped like what letter?

1. C
2. I
3. S
4. W

1-36. What is the symbol used for an American Standard channel?

1. SC
2. MC
3. C
4. [

1-37. A structural steel shape whose cross section resembles the letter L is a/an

1. bar
2. angle
3. tee
4. plate

1-38. In the designation of a structural steel angle having unequal legs, what dimsnsion should you list first?

1. Wider leg
2. Narrow leg
3. Thickness
4. Length

1-39. A flat structural steel shape having a cross section that measures 6 1/2 inches by 3/4 Inches is called

1. steel plate
2. sheet metal
3. bar

1-40. A 40-pound plate is the same as a

1. 1-inch plate
2. 2-inch plate
3. 1 1/2-inch plate
4. 2 1/2-inch plate

1-41. What structural shape should you specify for bracing and connecting heavy structural msmbers?

1. S-shape
2. C-shape
3. Angle
4. Flat or round bar

Learning Objective: Describe differing steel construction methods used for steel frame structures.

1-42. The processing of raw materials to form finished members of steel structures is called

1. election
2. manufacturing
3. prefabrication
4. fabrication

1-43. The rigging and hoisting of steel members to their proper places in a steel structure is part of what process?

1. Fabrication
2. Erection
3. Construction
4. Prefabrication

1-44. What method of steel construction uses masonry walls to support structural floor- and roof-framing members?

1. Skeleton
2. Long span
3. Wall bearing

1-45. Built-up girders, trusses, and bar joists are all commonly used in what method of steel construction?

1. Skeleton
2. Long span
3. Wall bearing

1-46. Horizontal structural members connecting the exterior columns of a skeleton structure are called

1. lintels
2. girders
3. floor beams
4. spandrel beams

1-47. In skeleton construction, by what means can the size of a structure be enlarged to provide additional floor space?

1. Add additional columns only
2. Add additional beams only
3. Add additional columns, beans, and girders
4. Add additional columns and beams only

1-46. A vehicle passes over a steel-truss bridge. In what order is the imposed loading from the truck transmitted through the bridge members to the supporting abutments?

1. Decking, stringers, transverse beams, trusses, end pedestals, bearing plates
2. Decking, trusses, stringers, transverse beams, bearing plates, end pedestals
3. Trusses, decking, transverse beams, stringers, end pedestals, bearing plates
4. Trusses, transverse beams, decking, stringers, end pedestals, bearing plates

1-49. Which of the following reasons is an advantage of preengineered metal structures?

1. They can be quickly erected
2. The individual members or components are factory-built
3. They are chipped as complete kits
4. Each of the above

Learning Objective: Identify common connectors used in steel frame structures.

1-50. In the military, what connectors are most comnonly used for steel construction?

1. Pins and welds
2. Pins and rivets
3. Bolts and welds
4. Rivets and bolts

1-51. What type of connector is used at the ends of bracing rods or where freedom of rotation is required?

1. Bolt
2. Pin
3. Weld
4. Rivet

1-52. In steel building construction, what type of connector is used more that any other type?

1. Weld
2. Bolt
3. Pin
4. Rivet

1-53. When bolts are used, how does the hole size compare to the nominal bolt size?

1. Half-size larger
2. Same size
3. Slightly smaller
4. Slightly larger

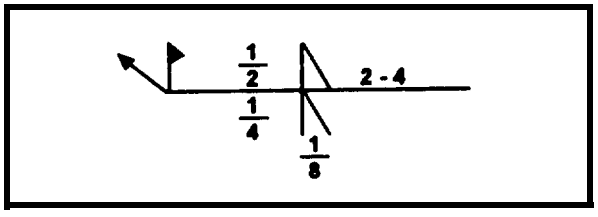

Figure 1B

IN ANSWERING QUESTIONS 1-54 THROUGH 1-56, REFER TO FIGURE 1B.

1-54. What type and size of weld is to be made on the “other side”?

1. 1/4-inch bevel weld
2. 1/4-inch vee weld
3. 1/2-inch fillet weld
4. 1/2-inch bevel weld

1-55. What does the numeral 4 mean?

1. The length of the weld in inches
2. The length of the weld in millimeter
3. The center-to-center spacing of the weld in inches
4. The center-to-center spacing of the weld in millimeters

1-56. What does the small flag shown in the symbol indicate?

1. The “other side” weld only is to be made in the shop
2. The “arrow side” weld only is to be made in the field
3. Both the “other side” and “arrow side” welds are to be made in the shop
4. Both the “other side” and “arrow side” welds are to be made in the field

1-57. When a reference is not required, what part of a welding symbol can be omitted?

1. The arrow
2. The reference line
3. The tail
4. The detail reference symbol

1-58. For structural work, the diameter of rivets most often used are

1. 1 and 1 1/4 inches
2. 3/4 and 7/8 inch
3. 1/2 and 5/8 inch
4. 1/4 and 3/8 inch

1-59. For a 1-inch-diameter rivet, what size hole should be drilled?

1. 1 inch
2. 1 1/16 inches
3. 1 3/16 inches
4. 1 1/4 inches

1-60. For structural steework, rivets are manufactured from what type of material?

1. Iron
2. Hard steel
3. Soft steel
4. Aluminum